Master's Thesis

The Risk of Inequality: A Quantitative Research Proposal Exploring Effects of Income Inequality on Risk-Taking

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Table of Contents

Abstract

Economic inequality has been rapidly increasing around the world. Increased income inequality has been associated with poorer financial and health outcomes. However, the mechanisms linking inequality to these outcomes is not fully understood. A recent study has posited that inequality may promote poor outcomes partly by increasing risky behavior. However, prior research has suggested an opposite effect, with greater inequality being linked to decreased risk-taking. This research proposal aims to reconcile the varying evidence regarding the effect of inequality on individual risk-taking. The proposed study employs primary and secondary quantitative analyses to assess the relationship between income inequality and individual decision-making with regards to risk in multiple populations. The primary analysis uses data from the Community Health Network (CHN) patients in New York City to understand the link between inequality and risk-taking in an underserved population (n=50,000). The secondary analysis uses data from a study aiming to test the replicability of Prospect Theory around the world (n=4,099). This dataset is used to measure inequality on a larger country-level scale. Finally, the suitability of risk-taking as a metric for understanding health behavior is assessed through the relationship between risk-taking and missed preventive appointments.

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Background and Significance

Statement of the Problem

In recent years, economic inequality has been on the rise in the US and around the world. In the United States specifically, economic inequality has sharply increased since the late 1970s (Saez, 2016). According to a Pew Research Center study, the wealth gap between America's richest and poorer families more than doubled from 1989 to 2016 (Schaeffer, 2020). This divide has been increasing more rapidly since the Great Recession of 2008, with the richest 1% of the population now controlling 40% of the nation's wealth, and the richest 20% of the population controlling 90% of the nation's wealth (Piketty, 2014; Wolff, 2017).

These increases in inequality have not been without consequence. Many world leaders have deemed income inequality as one of the most pressing problems of our time and have stressed its social costs (World Economic Forum, 2014). Increased economic inequality has so far been associated with higher rates of crime, greater consumer debt, and poorer health outcomes (Choe, 2008; Frank, 2013; Pickett & Wilkinson, 2015). Of the many health outcomes associated with inequality, many involve risk-taking and risky behaviors such as sexual promiscuity, violence, drug and substance abuse, and crime (Wilkinson & Pickett, 2006, 2009). Despite the overwhelming evidence for the association between increased economic inequality and poorer financial and health outcomes, the mechanisms linking the two are poorly understood.

Several studies have suggested that inequality may promote a range of poor outcomes, in part, by increasing risky behavior (Payne, Brown-Iannuzzi, & Hannay; 2017; Mishra, Hing, & Lalumière 2015). However, these studies were conducted as lab experiments with imposed economic inequality, which failed to consider how the relationship between inequality and risk-taking would be observed in the real-world. Replicating these findings in various real-world contexts – nationally and globally – will bolster our understanding of the true relationship between economic inequality and risk-taking, which will have far-reaching implications for society's financial and physical well-being.

Economic inequality

Economic inequality, a form of disparity, should not to be confused with income or poverty which are absolute measures. Rather, economic inequality is a measure of one's economic position relative to others. The distinction between inequality and poverty is an important one because higher inequality is associated with poorer outcomes even for individuals with average incomes. Several epidemiological studies suggest that places with unequal income distributions have poorer economic, health, and social outcomes even after controlling for individual income (Pickett & Wilkinson, 2015; Kawachi & Subramanian, 2014; Frank, 2013). Among economically developed countries, income distribution plays a larger role in health outcomes than income level (Wilkinson and Pickett, 2009).

Economic inequality can be measured in various ways, namely through the disparity in income or the disparity in wealth. Income inequality is the unequal distribution of income, while wealth inequality is the unequal distribution of assets. Wealth inequality is typically more extreme than income inequality and tends to vary less over time. Even so, both wealth and income inequality are associated with poor societal outcomes in largely the same way. Wealth however is much more difficult to accurately estimate, as there are multiple factors that make up an individual's assets and liabilities. The number of countries for which a measure of wealth inequality is available is also limited. Therefore, income inequality is a more commonly used metric of economic inequality (Saez & Zucman, 2016).

One factor to consider with regards to inequality is the level at which it is measured. We know that poorer health outcomes such as obesity, mental illness, higher crime rates, and decreased life expectancies are related to inequality on a societal level but it is unclear whether this association would hold on a more local scale or if the effects of inequality would vary across populations. Few studies have examined individual-level inequality and its impact on behavior.

While the link between income inequality and poorer outcomes has been corroborated, there is a lack of understanding as to how or why income inequality is associated with these outcomes. Recent studies suggest increased risk-taking as a potential pathway in which inequality affects numerous poor outcomes (Payne, Brown-Iannuzzi, & Hannay, 2017; Mishra, Hing, & Lalumière 2015).

Risk-taking

Risk has colloquially been understood as hazard, danger, or exposure to downside costs (Mishra, 2014). Specifically, in the disciplines of economics and psychology, risk is defined as the variance in decision outcomes or the intentional interaction with uncertainty (Payne, Brown-Iannuzzi, & Hannay, 2017). A behavior would be considered risky if, for example, there is a high payoff of low probability. High-risk decisions have a high potential reward but also a high potential for loss. Risk attitudes have traditionally been treated as exogenous and fixed. However, new evidence has emerged that choices under uncertainty are subject to both systematic variation and to social influence (Falk et al., 2016). Analyzing decision-making theories can provide a conceptual framework for understanding when inequality would motivate risk-taking behavior.

The prevailing economic theory for decisions under risk is expected utility theory, which views people as rational decision-makers who seek to maximize utility (happiness/satisfaction) in their choices. Under expected utility theory, individuals are posited to have consistent risk-preferences. Each individual's risk preference on a scale from risk-averse to risk-seeking is considered an inherent quality which does not alter with context (Friedman & Savage, 1948). Therefore, expected utility theory would predict that changing economic inequality would have no bearing on an individual's level of risk-taking.

In recent years, new theories have emerged to augment expected utility theory in instances where expected utility theory may fail to explain observed behaviors. The first is Prospect Theory, which extends the expected utility model and considers context and personal preferences to explain the instances in which an individual's decisions may go against what is deemed as "rational." Prospect Theory states that people are risk-averse when it comes to gains but risk-seeking when it comes to losses, where losses and gains are anchored around a reference point (Tversky & Kahneman, 1979). With increasing inequality, Prospect Theory would suggest that individuals would become more risk-seeking, as those on the unfavorable end of the inequality would consider themselves to be in a situation of loss compared to their privileged peers.

Risk-sensitivity theory is another decision theory that is more in line with Prospect Theory in that it views risk-preferences as context-specific. It predicts that individuals will shift

from risk-averse to risk-seeking decisions in situations of high need (Mishra, 2014). Need in this context is defined as the disparity between an individual's present state and the individual's desired state (Mishra & Lalumière, 2010). This theory is most relevant in the context of economic inequality because inequality creates a situation of need. Those who have less income relative to their peers will raise their expectations of their desired state because of their upward social comparisons (Collins, 1996). Therefore, similar to Prospect Theory, risk-sensitivity theory would predict that individuals would increase risk-taking if income were more unequally distributed.

Risk-sensitive decision making has been demonstrated to occur independent of stable individual differences in personality (Mishra & Lalumière, 2010). For example, one study demonstrated that people who were given a target goal for returns on financial investments chose riskier options when these target goals were higher compared to when they were lower (Mishra et al., 2012). Another study found that revealing information on relative performance in a tournament induces individuals trailing just behind the interim leaders to take greater risks (Genakos & Pagliero, 2012).

Several studies have explored the link between higher income inequality and increased risk-taking but most measured financial risk-taking. It is still unclear whether risk-preferences are consistent across domains (economic, social, health) or if the mechanisms by which inequality affects risk-taking is domain-specific. In other words, inequality could influence behavior across domains through a general "syndrome" of risky behavior or it may affect distinct domains of risk via separate pathways (Payne, Brown-Iannuzzi, & Hannay, 2017).

Inequality and risky health behaviors

Economic inequality has been associated with numerous negative societal outcomes including violence and homicide, poor physical and mental health, poor educational outcomes, high prisoner incarceration rates, obesity, low social mobility, reduced trust, poorer community life, increased drug use, and shorter life expectancies (Wilkinson & Pickett, 2006). Of the many health outcomes associated with economic inequality, many involve risk-taking and risky behaviors such as sexual promiscuity, violence, drug and substance abuse, and crime (Wilkinson & Pickett, 2006, 2009). It would therefore be plausible that increased economic inequality would

be associated with increased risk-taking not just in financial behaviors but also in health behaviors. However, this association has yet to be tested on an individual level.

Patient non-attendance for preventive health visits is one risky health behavior that has been associated with economic inequality and poorer health outcomes. Failure to utilize preventive care and participation in risky health behaviors are major contributors to morbidity, health disparities, medical care costs, and mortality (Simon, Soni, & Cawley, 2016). Patient no-shows impede health service delivery and decrease clinical efficiency, which can lead to negative health outcomes for patients and financial losses for healthcare providers (Samuels et al., 2015). The need to increase preventive care and improve health behaviors has been emphasized by the U.S. Surgeon General. As such, it will be important to understand if increased risk-taking is a mechanism by which economic inequality impacts preventive healthcare utilization.

Significance

There is a need for research examining the validity of risk-taking as a pathway by which income inequality leads to poor outcomes. The large body of evidence showing associations between income inequality and poor outcomes raise fundamental questions about the relationship between economic systems and the health and well-being of populations within these systems.

Past research has suggested that risky decision making, specifically financial decision making, may be one pathway by which inequality affects outcomes. However, these studies used small national samples within lab experiments focused on financial risk-taking to test this pathway. This fails to consider how risk-taking behaviors would change in real-world settings. In addition, it will be important to examine these relationships across different countries and contexts to improve the generalizability of the findings. One such context would be underserved communities, which have not specifically been studied in terms of their risk-taking behaviors. Finally, further research is necessary to understand the impact of economic inequality on risky health behaviors and if risk-taking could be a valuable metric in predicting undesirable health behaviors. Understanding the mechanism by which economic inequality affects health behaviors and outcomes can inform the design of better behavioral interventions which can result in improved health and wellbeing of populations.

Aims

The purpose of this proposal is to examine the effect of income inequality on individual behavior with regards to risk and to test the generalizability of this relationship in various populations and contexts. The following aims will guide the proposed research study:

1. Assess the relationship between income inequality and risk-taking in a global population
    a. Hypothesis: It is hypothesized that high economic inequality will be positively associated with risk-taking
2. Assess the relationship between income inequality and risk-taking among underserved communities in New York City
    a. Hypothesis: It is hypothesized that high income inequality will be positively associated with risk-taking
3. Determine the relationship between risk-taking and missed preventive appointments among underserved communities in New York City
    a. Hypothesis: It is hypothesized that greater risk-taking is positively correlated with missed preventive appointments

Accomplishing these specific aims will allow us to determine whether greater income inequality contributes to increased individual risk-taking behavior.

Research Design

Overview

In order to achieve the aforementioned aims, this study will involve a secondary analysis of data from the published study, *Replicating patterns of Prospect Theory for decision under risk* (Ruggeri et al., 2020). The study was conducted by Principal Investigator (PI) Dr. Kai Ruggeri from the Mailman School of Public Health, Columbia University. The primary aim of this study was to replicate Daniel Kahneman and Amos Tversky's 1979 study, entitled *Prospect Theory: An analysis of decision under risk* (Kahneman & Tversky, 1979) which contended that people were largely loss averse, and most people find losing a certain amount more aversive than gaining the same amount is appetitive. The multinational replication study aimed to bring the observations leading to the formation of Prospect Theory in line with the present standards of reproducibility in behavioral science. Additionally, it enabled empirical documentation of variability between locations and languages in key aspects of financial decision-making with risk (Ruggeri et al., 2020).

To further assess the relationship between economic inequality and risk-taking, particularly in underserved communities in New York City, the present study will also involve a primary analysis building on data from a second study entitled *Nudging New York: adaptive models and the limits of behavioral interventions to reduce no-shows and health inequalities* (Ruggeri, et al., 2020). This study aimed to identify predictors of missed healthcare appointments and to determine the effectiveness of a reminder intervention.

The data from the Prospect Theory study will be used to determine the relationship between income inequality and risk-taking in a variety of countries. A survey will be administered to the patients from the Nudging New York study to determine the relationship between income inequality and risk-taking specifically in an at-risk population. This primary survey data will be paired with the data on missed appointments to assess the relationship between risk-taking and no-shows.

Prospect Theory Dataset

Participants

The sample participants were recruited from 19 countries, varying in wealth, culture, development level, and language. There was no systematic method for language or location inclusion beyond the collaborators that volunteered to participate. While the selected countries skew towards Euro-American regions, the generally random nature of inclusion is helpful for avoiding some level of systematic bias for participants. All data was collected online so no in situ testing took place.

There were two tracks for recruiting participants for the study. The first was direct contact with convenience samples for general testing of the procedure, followed by participants recruited via paid sampling through Prolific (Ruggeri et al., 2020). Specifically, direct sample participants were recruited through convenience samples, direct contact, online forums, social media posts, email circulars, and various organizational membership channels. The direct sample surveys were collected via links sent to participants and hosted through Qualtrics. Survey questions were altered to be country specific and were translated to the appropriate languages.

Countries that exceeded the total desired power threshold of 218 participants through direct sampling did not make use of paid samples. In paid samples, all participants received the equivalent of the minimum hourly wage for their country, prorated for the estimated time to complete the survey. A breakdown of the samples per country is shown in Table 1. The total final sample consisted of 4099 adults.

Country	Language	Direct n	Paid n	Total n
Germany	German	186	141	327
Italy	Italian	155	147	302
UK	English	290	-	290
Australia	English	282	-	282
Mainland China	Simplified Chinese	259	-	259
Ireland	English	113	143	256
Serbia	Serbian	246	-	246
Hungary	Hungarian	101	142	243
USA	English	33	210	243
Norway	Norwegian	189	37	226
Slovenia	Slovenian	202	-	202
Spain	Spanish	199	-	199
Belgium	Dutch	127	65	192
Hong Kong	Traditional Chinese	160	-	160
Denmark	Danish	121	29	150
Chile	Spanish	89	56	145
Sweden	Swedish	106	33	139
Bulgaria	Bulgarian	98	29	127
Austria	German	70	41	111
Total		**3026**	**1073**	**4099**

Table 1. Samples per country by direct, paid, and total n.

Instrument

The survey instrument contained 27 total items, including 17 items involving choices with risk, an attention check item, and 9 demographic items. The demographic measures were presented after decision-making items to avoid stereotype threat influences. These measures included nationality, year of birth, gender, income, educational attainment, and four measures of current financial circumstances and behaviors (strain, recent changes, investments, debts). The US version of the instrument included one additional demographic item pertaining to financial circumstances. The items involving choices with risk asked participants to choose between two financial choices with probabilistic outcomes, such as:

Which option do you prefer?

a. A 20% chance of 4000 (25% chance of 0)
b. A 25% chance of 3000 (75% chance of 0)

While the above item presents financial choice in the gain frame, there were other items which presented financial choices in the loss frame. All items involved hypothetical monies only.

The full instrument (altered for the US) is included in Appendix B. To adjust the instrument for the various sample locations, financial values in each item were adjusted directly toward median net household incomes in each country for June 2019. Additionally, forward and back translation was used for all measures. The forward and back translation process is documented in Figure 1.

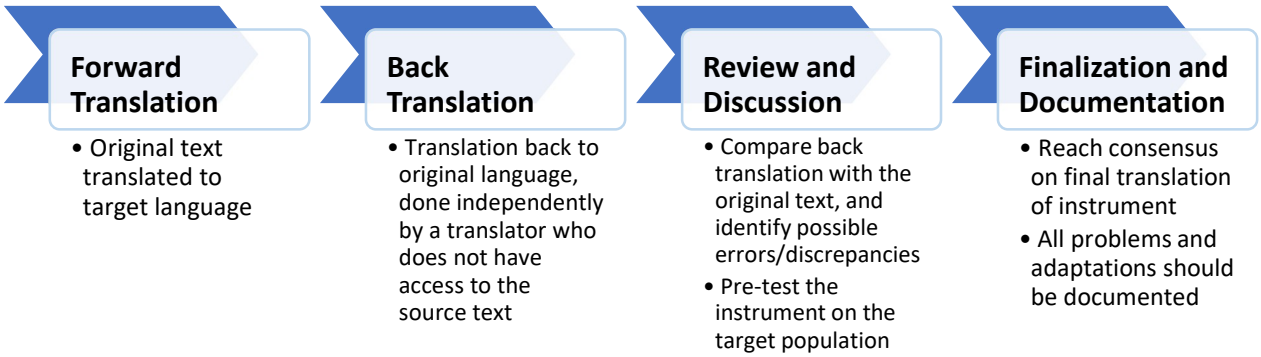

Figure 1. Process of translation and adaptation of instruments

Procedure

All participants within each country completed identical surveys of 27 total items, including demographics. After providing informed consent, participants responded to 17 choices with risk. The language of the surveys was adapted to each country and the monetary amounts used were adjusted to local purchasing power. The order of the choice items was randomized. At the end of the survey, participants were asked if they were familiar with the concept of loss aversion, as a proxy for general awareness of behavioral economics. All participants were tested over a 15-day window in July-August 2019.

Benefits and Limitations of Dataset

The benefit to using the Prospect Theory dataset for this study is that it covers a large number of countries and the sample size is much larger than similar datasets in this domain. The large sample size and wide variety of countries included would increase external validity of any findings. In addition, the author of this thesis was involved in the data collection process, making her more familiar with the dataset and its nuances. The dataset is limited in that the original survey instrument was not meant to be used to assess risk-taking specifically. Instead it was designed to measure the difference in a participant's risk preference in the gain frame versus the loss frame. Therefore, the survey needs to be repurposed and modified to fit the needs of this study. Additionally, a limited number of demographic variables were collected which limits the ability to measure potential confounding. Only the variables collected can be controlled for as potential confounders. Finally, items in the survey instrument involve hypothetical monies only, which is in line with the original Prospect Theory study. There is a concern that risk-taking behaviors could differ when real money is involved. However, multiple studies have shown that answers to survey items using hypothetical money do not change when real money is involved (Kühberger et al., 2002; Beattie & Loomes, 1997; Wiseman & Levin, 1996).

Nudging New York Dataset

Participants

Researchers collaborated with an external partner, the Community Healthcare Network (CHN) - a Federally Qualified Health Center (FQHC) network - to collect patient data. CHN serves underserved populations that are exposed to vast socioeconomic disadvantages. Approximately 67% of CHN's patients are at or below the Federal Poverty Level (FPL) and a vast majority are people of color.

The participants in this study were CHN patients with primary care appointments between June 2017 to April 2018. All patients consented to their health information being shared for research purposes. Therefore, enrollment was complete prior to any analysis commencing. The participants were aged 18-65, with 67% being female.

Procedure

This was a retrospective observational study which used electronic medical record (EMR) data from 11 of CHN's 15 facilities in New York City. EMR data was collected for June 2017 to April 2018. This data included 53,149 visits for 41,495 unique patients and captured attendance rates and patient characteristics such as age, gender, income, and address. This data was integrated with other sources of clinical, behavioral and environmental data to include public transportation, environmental factors, and emergency room visits.

Primary Analysis

While this dataset includes attendance rates for preventive appointments, it does not capture a patient's risk preferences. In order to measure risk-taking, the survey instrument from the Prospect Theory study will be modified and administered to the patients in this dataset. The survey will be distributed to all CHN patients in the 11 New York City clinics. The information garnered from the survey will be merged with the patient data for further analysis.

Strengths and Limitations of Dataset

The reason for using the Nudging New York dataset as a basis for the subsequent primary analysis is that it captures data on an underserved population with respect to risky health behavior which is well-suited to address the aims of this study. In addition, there is no additional cost to acquiring the data. A limitation of this dataset is the lack of control over data quality and the fact that a measure of risk-taking is not already incorporated into the dataset. However, administering the modified Prospect Theory survey imposes minimal cost and effort and therefore does not preclude us from using this dataset.

Data Collection Methods

The two main variables to be measured in the secondary analysis are income inequality and risk-taking. Income inequality will be measured using Gini coefficients at both the country and zip code level. Risk-taking will be measured using the modified Prospect Theory survey instrument. These measures will be merged onto the Prospect Theory and Nudging New York datasets before beginning the analysis.

Income inequality

In order to measure income inequality, a country-level and zip-code level Gini coefficient (also referred to as a Gini index) will be used. The Gini coefficient is a popular summary measure of the degree of inequality and ranges from 0 in the case of perfect equality to 1 in the case of perfect inequality. It is derived from the Lorenz curve, which ranks the population from poorest to richest, and shows the cumulative proportion of the population on the horizontal axis and the cumulative proportion of expenditure or income on the vertical axis (Haughton & Khandker, 2009).

The Gini coefficient is the most widely used single measure of inequality (Haughton & Khandker, 2009). Possibly because it satisfies the criteria for what makes a good measure of income inequality (Haughton & Khandker, 2009). These criteria include:

- *Mean interdependence*: If all incomes were doubled, the measure would not change
- *Population size independence*: If the population were to change, the measure of inequality should not change, all else equal
- *Symmetry*: If any two people swap incomes, there should be no change in the measure of inequality

It should be noted that the Gini coefficient does not distinguish between inequality driven by greater wealth among the wealthy versus inequality driven by greater poverty among the poor (Payne, Brown-Iannuzzi, & Hannay, 2017).However, it will not be a limiting factor in this study because we are concerned with the impact of any inequality, regardless of individual income.

The country-level Gini index will be drawn from the World Bank estimates.

Country	GINI index	Most recent year
Australia	34.4	2014
Austria	29.7	2017
Belgium	27.4	2017
Bulgaria	40.4	2017
Chile	44.4	2017
China	38.5	2016
Denmark	28.7	2017
Germany	31.9	2016
Hong Kong	53.9*	2016
Hungary	30.6	2017
Ireland	32.8	2016
Italy	35.9	2017
Norway	27.0	2017
Serbia	36.2	2017
Slovenia	24.2	2017
Spain	34.7	2017
Sweden	28.8	2017
United Kingdom	34.8	2016
United States	41.4	2016

Table 2. GINI index by country. Source: https://data.worldbank.org/indicator/SI.POV.GINI

**Hong Kong data not available in World Bank dataset. Data from the Hong Kong Census and Statistics Department. Source: https://www.censtatd.gov.hk/press_release/pressReleaseDetail.jsp?charsetID=1&pressRID=4180*

The country-level Gini coefficients will be matched with the countries in the Prospect Theory dataset. It should be noted that there is no available data for the Hong Kong Gini index in the World Bank data source. However, an estimate was found through the Hong Kong Census and Statistics Department. As this is the only country which does not have a Gini listed in the World Bank dataset, and it has unique characteristics being a city-state, Hong Kong will be excluded from the analysis. Using multiple datasets to source income inequality figures would detract from the internal validity of the study findings as it would introduce inconsistencies in the measurement of inequality.

In order to assess inequality among the underserved New York population, a zip code level Gini coefficient will be used. The Gini coefficient for each zip code in New York City will be sourced from the Census Bureau's American Community Survey which was most recently

conducted in 2014 (U.S. Census Bureau, 2014). These Gini coefficients will be merged with the Nudging New York patient data based on patient addresses.

Risk-taking

Economic risk-taking has typically been measured using hypothetical choices between a safe option and a lottery option (Falk et al., 2016). While the Prospect Theory survey was not designed for the purposes of this study, many of the survey items are in line with typical methods of measuring risk-taking. This is particularly true for items that involve the certainty effect, where a certain option is pitted against an option with lower probability. The following is an example of a certainty effect survey item:

Which option would you prefer?

a. An 80% chance of gaining $8,000 (20% chance of $0)
b. A 100% guarantee of gaining $6,000

Choosing option A in this scenario would indicate greater risk-taking because the outcome is less certain. Additionally, survey items presenting an option with low probability of a high payoff versus an option with a high probability of a low payoff also predict risk-taking. For example:

Which option do you prefer?

a. A 45% chance of gaining $12,000 (55% chance of $0)
b. A 90% change of gaining $6,000 (10% chance of $0)

Again, choosing option A would indicate greater risk-taking as the payoff of $12,000 is higher than $6,000 but the probability of this payoff is lower.

According to Prospect Theory people have different risk preferences when it comes to losses versus gains (Kahneman & Tversky, 1979). Because of this, only survey items in the gain frame were included in the modified survey for the sake of simplicity. The modified survey uses five questions from the original Prospect Theory survey and can be found in Appendix C. Items in the gain frame involving either the certainty effect or a choice between a safe option and a lottery option were selected for inclusion in the survey instrument. These questions were chosen because of their simplicity and their predictive effect of risk-taking (Falk et al., 2006).

The strengths of using this survey to measure risk-taking are that it isn't overly lengthy, items are easy to understand, and it can be administered in under 5 minutes. One limitation of using the Prospect Theory survey to measure risk-taking is that it relies on self-reports of the likelihood of risk-taking as opposed to real-world risk-taking. Respondents may not answer truthfully, or the way they answer may not correspond to how they would act in a real-world scenario. However, this limitation is not of great concern because self-reports of the likelihood of risk-taking in hypothetical decision situations have been found to correlate with real-world risk-taking in a variety of settings (Hanoch et al., 2006).

From the survey responses, a risk-index can be calculated by summing the number of times a risky option was selected over a safer option. The index would be categorical, ranging from 0 to 5, given that there are five survey items in the modified instrument.

Analytical Methods

All quantitative analyses can be conducted in any statistical software, such as SPSS, Stata, SAS, or R. The first step in the analysis will be to analyze the descriptive statistics of the samples to gain an understanding of the distributions of demographic variables. Frequency tables displaying participant demographics for variables such as age, gender, highest level of education, and income will be created.

Next, a univariate analysis of the risk-taking index will be conducted to determine the distribution of risk-taking scores, measures of central tendency (mean, median, and mode), and the standard deviation. If the distribution is skewed in any direction, as in most participants have a score of 0 or a score of 5, this would indicate that the risk-taking index is not sensitive enough and may not be the best way to measure risk-taking.

The quantitative analysis should also ideally uncover any significant associations or correlations present within the data. Bivariate analyses can be utilized to determine whether certain variables were associated with one another.

In order to assess the relationship between income inequality and risk-taking, a logistic regression will be run with the risk-taking index as the dependent variable and the Gini coefficient as the independent variable. A logistic regression is preferred over a chi-square test

because of the ability to control for potential confounders. The logistic regression model will include gender, age, education level, and income level as covariates because all have been found to be associated with risk-taking (Falk et al., 2015).

Similarly, to assess the relationship between risk-taking and missed appointments, a logistic regression will be run with missed appointments as the dependent variable and the risk-taking index as the dependent variable. Again, gender, age, education, and income will be included as covariates.

Data Management

All data used in this study will be encrypted and governed by HIPAA guidelines. Researchers will sign a non-disclosure agreement related to viewing/accessing data at CHN. All personal identifiers such as social security numbers will be deleted from the CHN dataset. The Prospect Theory dataset does not include any personal identifiers. However, respondents to the risk-taking survey can be assured that any information provided in the survey will be kept confidential. The survey data will be obtained through Qualtrics, a survey software. The Qualtrics website requires an individual to have login credentials to access any information gathered from the distributed survey. All analyses will be conducted on merged and non-identifiable data. The datasets will not be shared with any other parties.

Feasibility

The accessibility of the datasets and overall low cost of the research design make this study feasible. The sampling design and data collection methods are relatively inexpensive and were chosen for their efficiency. However, there are several ethical concerns and implications of this research study.

One major consideration is that many of the participants in the second portion of this study are low-income people of color. Given the fraught public health history of treating underserved populations as test subjects instead of partners in mutually beneficially research, we must exercise great caution when working with these vulnerable populations. It is imperative to convey the voluntary nature of the research to all participants through informed consent forms. Participants will also be made aware of the option to remove themselves from the study at any time. Participant consent will be obtained before any data collection begins. The informed consent form used in the Prospect Theory study which will also be used when collecting data among the CHN network can be found in Appendix A.

Another important ethical consideration is participant privacy and the confidentiality of the data collected. In order to protect the privacy of the participant, data will be aggregated and anonymized and will only be made available to members of the research team. De-identified data will not be shared with the general public until it has been processed and analyzed.

Finally, participation in this proposed study does not provide any direct benefit to individuals who participate. Those involved in this study must be made aware of their lack of direct benefit. However, there is minimal risk associated with participation, so this should pose no ethical issues.

Discussion

Strengths

This proposed study has several strengths in that it addresses a gap in existing knowledge surrounding the relationship between income inequality and financial risk-taking in various populations and contexts. It also assesses whether risk-taking is a meaningful metric for understanding behavior as it pertains to missed preventive appointments. While this research study cannot imply causation between economic inequality and risk-taking, it could demonstrate an association between the two variables and add to the existing literature around this topic. Understanding the mechanisms by which economic inequality impacts health behaviors, namely through risk-taking, could allow for better tailored health interventions and eventually lead to improved public health. The large sample size of the study is also a major strength as it allows for greater power of the statistical conclusions and for greater generalizability.

Another major advantage of this study is that it utilizes a secondary analysis of existing data, making it low-cost and more efficient. All necessary data/variables for this analysis are contained in the Prospect Theory and Nudging New York datasets, except for a measure of risk-taking among the CHN patients. In addition, the author of this proposal was involved in the data collection process for the Prospect Theory dataset, so she is aware of the study-specific nuances and anomalies in the data collection process that would be important to the interpretation of specific variables in the dataset.

Limitations

While this study has many strengths and fills a gap in the public health literature, there are also several limitations to be considered. As this is a cross-sectional study, correlations between income inequality and risk-taking can be examined, however, causation cannot be determined. Cross-sectional studies are more of a snapshot and do not follow participants over time. Therefore, ambiguous temporal precedence could be a major threat to internal validity. However, temporal precedence does not seem to be of concern in this study because it is unlikely that risk-taking would affect income inequality as income inequality is a relational measure and risk-taking is an individual measure. Therefore, if an association between income inequality and

risk-taking were found, it would be reasonable to assume that income inequality is a factor that leads to risk-taking and not the other way around. However, since causation cannot be implied, there could be a third variable that confounds the relationship. In order to further address this threat, controlling for additional factors that could impact the relationship between inequality and risk-taking will be important.

Additionally, much of the data used in this proposal come from existing data sources which were not designed to specifically address the aims of this study. This is often a challenge in secondary analyses; however, the datasets were particularly selected because: (1) they were deemed sufficient in addressing the study aims, (2) the data were relatively current, and (3) the author of this thesis was involved in the data collection process making her familiar with any nuances. This type of internal secondary analysis mitigates concerns around data accuracy and unfamiliarity with the datasets.

Another limitation of this study is that it relies on data from the World Bank and the U.S. Census Bureau for the Gini index which is updated on an annual basis. This means that the data may not be completely representative of current economic inequality. If economic inequality is measured at a different time-point from risk-taking, the observed relationship between the two could be diminished. The Census also may not capture transient people who do not have a permanent home, or undocumented individuals who are afraid to respond to the survey, which could bias the results.

There are also certain limitations in terms of how economic inequality is measured. First, the use of income inequality as a measure of economic inequality neglects an individual's wealth. Previous studies have suggested that wealth plays a factor in determining risk-seeking behaviors (Nishi, Shirado, & Rand, 2015). Both wealth inequality and income inequality are highly correlated but wealth inequality is typically more extreme. Currently, accurate and comparable measures of wealth inequality around the world are not available. As wealth measures continue to develop, future research should study the relationship between wealth inequality and risk-taking. Another factor worthy of note is that observed income inequality may differ from perceived income inequality. It will be important to understand if the relationship between income inequality and risk-taking remains the same if individuals are unaware of the inequality or if they perceive the inequality to be lesser than it is in reality. Similarly, the scale at

which an individual perceives inequality will be important. Is inequality more impactful at a national level, county level, or neighborhood level? Further studies should investigate differences in perceived versus actual inequality on risk-taking and whether the level at which inequality is measured plays a role in this relationship.

In the Prospect Theory dataset specifically, there is a concern of the Euro-American skew of the country selection. There is no representation of countries in Africa and limited representation of South American and Asian countries. Despite these limitations, this study is still valuable in that it will add to the growing body of research on income inequality and provides insights on the specific countries and populations that were studied. Further research could expand upon this study and examine the relationship between income inequality and risk-taking in other populations, particularly in Africa, Asia, and South America. More studies on this relationship in various populations, would attest to the universality of the relationship. In addition, representation from these continents could shed more light on cultural factors that may mediate the relationship between income inequality and risk-taking behaviors.

The findings in the Nudging New York dataset may also be limited and biased in that individuals who miss preventive appointments may be less likely to respond to the risk-taking survey. Conversely, those who do not miss appointments would be more likely to respond to the survey. While there is no way to address this response bias, it is simply a consideration to keep in mind. We must also exercise caution when generalizing the findings of the Nudging New York data. Since only New York City clinics are used to collect patient data, the findings will only be generalizable to similar urban settings and cannot be used to make assumptions about suburban or rural settings.

A final limitation of this study is that it does not consider emotion as a proximate mechanism that links inequality and risk-taking. Inequality facilitates negative emotions such as anger, annoyance, and frustration (Dawes et al., 2007). These affective responses to inequality have been in turn linked with increased risk-taking behavior (Fessler et al., 2004; Leith & Baumeister, 1996). Future studies should examine the mechanisms that may mediate or moderate the relationship between inequality and risk-taking behavior.

Conclusions

To sum up, this research proposal aims to: (1) assess the relationship between income inequality and risk-taking globally, (2) assess the relationship between income inequality and risk-taking in an urban underserved population, and (3) determine the relationship between risk-taking and missed preventive appointments among underserved communities in New York City. It builds off of prior research on inequality and risk-taking and seeks to increase the generalizability of the findings by studying multiple populations and contexts (Payne, Brown-Iannuzzi, & Hannay, 2017). The use of secondary analysis methods makes this proposal particularly feasible in terms of cost and efficiency. This proposed study will be able to address a gap in the existing literature with regards to the impact of inequality in real-world settings on risk-taking. With rising inequality in the US and around the world, it will be important to understand the impact of inequality on human behavior. This study has potential implications for designing better interventions which can result in improved health and wellbeing of populations. While there is a need for further research beyond this proposal, the hope is that this study acts as one piece of the larger puzzle.

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Appendix A. Consent form

Information and Consent

The following survey asks questions about your preferences regarding financial choices. You will be presented with a series of questions with various options where you have to pick between risky and certain outcomes. There are no right or wrong answers to these questions, just pick whichever option you prefer. Afterwards, you will be asked some questions about your background. These are broad questions that do not allow you to be identified personally. The information we collect from you will only be used for the purposes of academic research. No one will contact you after.

The entire survey should take about three to four minutes. If you have any questions or concerns, please contact Dr Kai Ruggeri at dar56@cam.ac.uk.

By participating, you confirm the following:

- *you are at least 18 years of age*
- *you are a permanent resident of [COUNTRY WHERE ADMINISTERED]*
- *you consent to participate in the study*
- *you consent to your data used for the research described above*
- *you understand that your participation is completely anonymous*
- *you understand that you may stop at any time.*

If this is correct, please choose the option below and proceed to the survey.

O I confirm these are accurate, that I understand the terms, and agree to participate in this study.

Appendix B. Original Prospect Theory Survey

You are about to be asked several questions about your own preferences. There are no right or wrong answers. Some questions may appear similar, but please answer each question on its own. Once you move to the next question, you are not able to return to change an answer. When you are ready, please click the button below.

1. Which option do you prefer?
    a. A 33% chance of gaining $5,000, a 66% chance at $4,800, and a 1% chance of $0
    b. Guaranteed $4,800

2. Which option do you prefer?
    a. 33% chance of gaining $5,000 (67% chance of $0)
    b. A 34% chance of gaining $4,800 (66% chance of $0)

3. Which option do you prefer?
    a. An 80% chance of gaining $8,000 (20% chance of $0)
    b. A 100% guarantee of gaining $6,000

4. Which option do you prefer?
    a. A 20% chance of gaining $8,000 (25% chance of $0)
    b. A 25% chance of gaining $6,000 (75% chance of $0)

5. Which option do you prefer?
    a. A 45% chance of gaining $12,000 (55% chance of $0)
    b. A 90% chance of gaining $6,000 (10% chance of $0)

6. Which option do you prefer?
    a. A 0.1% chance of gaining $12,000 (99.9% chance of $0)
    b. A 0.2% chance of gaining $6,000 (99.8% chance of $0)

7. Which option do you prefer?
    a. An 80% chance of losing $8,000 (20% chance of losing $0)
    b. A 100% guarantee of losing $6,000

8. Which option do you prefer?
    a. A 20% chance of losing $8,000 (80% chance of losing $0)
    b. A 25% chance of losing $6,000 (75% chance of losing $0)

9. Which option do you prefer?
    a. A 45% chance of losing $12,000 (55% chance of losing $0)
    b. A 90% chance of losing $6,000 (10% chance of losing $0)

10. Which option do you prefer?
    a. A 0.1% chance of losing $12,000 (A 99.9% chance of losing $0)
    b. A 0.2% chance of losing $6,000 (A 99.8% chance of losing $0)

11. Imagine you are playing a game with two levels, but you have to make a choice about the second level before you know the outcome of the first. At the first level, there is a 75% chance that the game will end without you winning anything, and a 25% chance that you will advance to the second level. What would you choose in the second level?
    a. An 80% chance of gaining $8,000 (20% chance of $0)
    b. A 100% guarantee of gaining $6,000

12. Imagine we gave you $2,000 right now to play a game. Which option would you prefer?
    a. A 50% chance to gain an additional $2,000 (50% chance of gaining $0 beyond what you already have)
    b. A 100% guarantee of gaining an additional $1,000

13. Imagine we gave you $4,000 right now to play a game. Which option would you prefer?
    a. A 50% chance you will lose $2,000 (50% chance of losing $0)
    b. A 100% chance you will lose $1,000

14. Which option do you prefer?
    a. A 25% chance of gaining $12,000 (75% chance of $0)
    b. A 25% chance of gaining $8,000 (25% chance of gaining $4,000; 50% chance of gaining $0)

15. Which option do you prefer?
    a. A 25% chance of losing $12,000 (75% chance of losing $0)
    b. A 25% chance of losing $8,000 (25% chance of losing $4,000; 50% chance of losing $0)

16. Which option do you prefer?
    a. A 0.1% chance at gaining $10,000 (99.9% chance of $0)
    b. A 100% guarantee of $10

17. Which option do you prefer?
    a. A 0.1% chance of losing $10,000 (99.9% chance of losing $0)
    b. A 100% guarantee of losing $10

Attention item (Sixth item for all participants; Not randomized with other items)

18. Which option do you prefer?

    a. A 100% guarantee of gaining $10,000 (Do not choose this option, just proceed to

the next question)

b. A 99% guarantee of losing $5,000 (Do not choose this option, just proceed to the next question)

19. What year were you born? [Dropdown list from 1901-2001]

20. Which do you identify as?

Male Female Other _____ Prefer not to answer

21. What was your total personal income (after taxes) in 2018? Please provide this in US Dollars with no symbols or punctuation.

22. In the past month, your financial situation…

(1) Became much worse (2) Became a little worse (3) Has not changed
(4) Became a little better (5) Became much better

23. How did you handle your bills for the last month?

(1) I could not pay all my bills last month
(2) I had to take on a lot of debt to pay bills last month
(3) I had to take on some debt to pay them
(4) I paid everything but saved nothing
(5) I paid everything and saved some
(6) I paid everything, saved some, and paid down other debts (liked credit cards, auto, mortgage)
(7) Everything is paid off and I have enough to save, invest, or spend freely

24. What is your highest level of education completed?

Primary school Secondary school (high school)
Vocational school College or university (Bachelors or equivalent)
Graduate (Masters or equivalent) MBA
Doctoral degree

25. In a given month, what is your typical credit/debt situation? Do not include rent/mortgage or functional bills such as auto payments or utilities (e.g., electricity).

(1) My debts increase beyond what I earn in a given month
(2) I generally pay off only/mostly the interest but not the balance
(3) I make the minimum payment and the interest is charged
(4) I pay off much of the balance
(5) I pay off any balances every month
(6) I never purchase anything on credit or take on debt

26. Do you earn additional income from any of the following?

Private investments (stocks, mutual funds)
Property that you rent out
Ownership in a business other than where you work
A retirement account paid into regularly
I do not have any of these

27. In the past month, how hard has it been for you to pay for the very basics like food, housing, medical care, and heating?

(1) Very hard (2) Hard (3) Somewhat hard (4) Not very hard

28. True or false: Research shows that people dislike losing more than we like winning.

True
False
I do not know, but my **guess** is that it is **true**
I do not know, but my **guess** is that it is **false**

Appendix C. Modified Risk-Taking Survey Instrument

You are about to be asked several questions about your own preferences. There are no right or wrong answers. Some questions may appear similar, but please answer each question on its own. Once you move to the next question, you are not able to return to change an answer. When you are ready, please click the button below.

1. Which option do you prefer?
    a. A 33% chance of gaining $5,000, a 66% chance at $4,800, and a 1% chance of $0
    b. Guaranteed $4,800
2. Which option do you prefer?
    a. An 80% chance of gaining $8,000 (20% chance of $0)
    b. A 100% guarantee of gaining $6,000
3. Which option do you prefer?
    a. A 45% chance of gaining $12,000 (55% chance of $0)
    b. A 90% chance of gaining $6,000 (10% chance of $0)
4. Which option do you prefer?
    a. A 0.1% chance of gaining $12,000 (99.9% chance of $0)
    b. A 0.2% chance of gaining $6,000 (99.8% chance of $0)
5. Which option do you prefer?
    a. A 0.1% chance at gaining $10,000 (99.9% chance of $0)
    b. A 100% guarantee of gaining $10